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RESEARCH ARTICLE

DEVELOPING A FRAMEWORK FOR INTEGRATING CIRCULAR ECONOMY PRINCIPLES INTO PUBLIC PROCUREMENT

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ABSTRACT
The study examined "Developing a Framework for Integrating Circular Economy Principles into Public Procurement". The study aimed to develop a comprehensive framework for integrating circular economic principles into public procurement processes in Nigeria, using a case study approach to explore practical applications and outcomes. The study employed a mixed research design comprising quantitative data and case study approach. The quantitative aspect utilized a sample size of 110 respondents who were drawn from a population of 150 procurement professionals. Descriptive statistics and ANOVA were applied to analyze the quantitative data. Two research hypotheses were formulated and tested at 0.05 level of significance. The p-values obtained are: 0.01; 0.00; 0.28 and 0.49 respectively. $H0_1$ was rejected, while $H0_2$ was accepted. The results show that: there are potential positive impacts of integrating circular economy principles into public procurement on sustainability in Nigeria; and a novel framework was developed to facilitate the integration of circular economy principles into public procurement practices in Nigeria. The study recommends among others, training and capacity building of procurement professionals who are to implement "Circular Economy" principles. The study contributed by developing a framework that public sector organizations can use to integrate circular economy principles into their procurement processes.

Keywords: Circular economy; regulatory compliance; capacity building; resource efficiency; community engagement.

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1.0. INTRODUCTION

The circular economy represents a transformative approach to production and consumption that emphasizes sustainability, efficiency, and waste reduction. The concept of circular economy implies a systemic shift aimed at promoting long-term sustainability by eliminating waste, reusing products and materials, and regenerating natural systems, (Kirchherr, Yang, Schulze-Spüntrup, Heerink, & Hartley, 2023). The circular economy, as opposed to the traditional linear economy, which operates on the 'take, make, dispose' model, emphasizes restorative and regenerative concepts, (Skawińska, & Zalewski, 2021). The circular economy strives to reduce waste by reusing, repairing, refurbishing, and recycling existing resources and products (Khaw-ngern, Peuchthonglang, Klomkul, & Khaw-ngern, 2021).

The circular economy reduces environmental degradation by prolonging the lifecycle of products and materials, which not only reduces demand for natural resources, (Blomsma, & Tennant, 2020). This strategy promotes economic growth by opening up new business options, increasing resource efficiency, and encouraging innovation in product design and services, (Surya, Menne, Sabhan, Suriani, Abubakar, & Idris, 2021). It aims to divorce economic growth from the consumption of limited resources, advocating a more sustainable approach to production and consumption. Recently, the Circular Economy (CE) concept has gained increased importance by focusing on transforming waste into resources while bridging production and consumption activities, (Çimen, 2021). This is achieved by closing loops of different types and levels of recovery of valuable resources between parties in society, (Hapuwatte, & Jawahir, 2021).

In the practical implementation of Circular Economy, scholars generally identify three levels of initiatives: the micro level of firms and organizations, the meso-level of networks and the macro level of policy and regulations, (Vlados, & Chatzinikolaou, 2020). At macro level, the first impulses of governmental and policy initiatives to accelerate the Circular Economy transition have been taking place at national and international levels, (Alonso-Almeida, & Rodríguez-Antón, 2020). With policy engagement at European level emerging from the launch of the European Action Plan for the Circular Economy by the European Commission (EC) in 2014 and by the communication of the Circular Economy Package in 2015, (Friant, Vermeulen, & Salomone, 2021). Governments worldwide, including China, Japan, the UK, France, Finland, and the Netherlands, have included the notion of Circular Economy into their national objectives and programs, (Abu-Bakar, Charnley, Hopkinson, & Morasae, 2023). Scientific interest in the public sector's participation in the Circular Economy transition is primarily focused on macro-level policy analysis and regulation, (Ghazanfari, 2023).

The growing need for sustainable development has pushed the circular economy (CE) idea to the forefront of current economic and environmental policies, (Herrador, Cho, & Park, 2020). As countries struggle with resource depletion, waste management issues, and climate change, the transition from a linear "take-make-dispose" model to a circular economy has gained increasing popularity. The circular economy emphasizes waste reduction, product and material reuse, and natural system regeneration as ways to promote sustainability and resilience, (Joensuu, Edelman, & Saari, 2020); and (Awan, Kanwal, & Bhutta, 2020).

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Integrating circular economy principles in Public Procurement (PP) is one of the options to create fundamental change and contributing to making societies more sustainable. In the EU, PP on goods and services accounts from between 16% and 40% of GDP, (Nikolaou, Tsalis, & Vatalis, 2022), which represents a huge opportunity to transition the European economy to a more sustainability orientated society. Given the purchasing power of public organizations, considerable demand for sustainable products and services can, therefore, be promoted, (Lăzăroiu, Ionescu, Uță, Hurloiu, Andronie, & Dijmărescu, 2020). Integrating circular economy ideas into public procurement is more than just a theoretical exercise; it is a practical requirement for achieving sustainable development goals, (Klein, Ramos, & Deutz, 2020). As such, this research sits at the intersection of sustainability science, public policy, and economic innovation, with the goal of charting a realistic path to a more sustainable and resilient future.

Despite the theoretical benefits, the practical use of circular economy principles in public procurement remains hard due to some limitation, (Kristensen, Mosgaard, & Remmen, 2021). These limitations include a lack of standardized frameworks, low awareness and expertise among procurement officials, and the pervasiveness of old procurement procedures, (Al-Raqeb, Ghaffar, Haitherali, & Gopakumar, 2024). To address these challenges necessitates a strong framework that embraces circular economy principles while also aligning with the current regulatory and operational landscape of public procurement of Nigerian economy.

In recent years, the circular economy has received a lot of attention as a long-term alternative to the old linear economic paradigm. However, the application of circular economy ideas to public procurement processes is still underexplored and advanced. Public procurement, which accounts for a substantial portion of national gross domestic products (GDPs) and has significant environmental and social consequences, provides an important opportunity to accelerate the transition to a circular economy. Despite the potential benefits, there is a scarcity of comprehensive frameworks to help public institutions incorporate circular economy ideas into their procurement operations in Nigeria.

The aim of this study is to create a complete framework for incorporating circular economy ideas into public procurement, with a case study methodology to provide contextual insights and practical assistance. The objectives study are: evaluate potential impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria; and develop a comprehensive framework to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria. The findings of this study are expected to contribute to the larger conversation on sustainable public procurement and provide actionable recommendations for policymakers and practitioners working to advance the circular economy agenda in Nigeria and beyond.

1.2. Research Question

The following research questions apply to this study:

i. What are the potential impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency?

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ii. How can a comprehensive framework be developed to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria?

1.3. Research Hypothesis

The following research hypotheses were formulated for the study:

$H0_3$: There are no potential impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria.
$H0_4$: There is no comprehensive framework to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria.

2.0. CONCEPTUALIZATION AND LITERATURE REVIEW

2.1. Perspective in Circular Economy

Over the last 150 years, our industrial economy has been driven by a one-way production and consumption paradigm in which commodities are made from raw materials, sold, utilized, and then disposed of as waste, (Rashid, & Malik, 2023). While the concept of a circular economy has been debated since the 1970s, the transition from the present linear economic model to a circular one has recently gained traction among large global corporations and legislators, (Kovacic, Strand, & Völker, 2020). In preparation for the World Economic Forum 2012 in Davos, the Ellen MacArthur Foundation (EMF) and McKinsey Company produced a paper evaluating the potential benefits of the transition to a circular economy (Werning, & Spinler, 2020). It might generate an annual opportunity of $630 billion for only a subset of the European Union's (EU) manufacturing sectors (Wernicke, 2021). In addition to the enormous economic benefits, the EMF highlighted the considerable environmental and social benefits of a circular economy. These results raised a lot of awareness about the problem, and many businesses were eager to take advantage of this potential revenue opportunity.

Circular economy is currently a popular concept for future sustainable development promoted by the European Union and by several national governments like: China; Japan; UK; France; Canada; The Netherlands; Sweden; and Finland, etc, (Abad-Segura, Fuente, González-Zamar, & Belmonte-Ureña, 2020. Also, many businesses throughout the world have used the circular economy in their production sectors to save energy and raw materials. However, for the time being, the concept of circular economy is a combination of nebulous ideas from many technological domains and semi-scientific concepts, (Galatti, 2022).

On the macroeconomic level, ecological economics has a long legacy of recycling and other Circular Economy-related topics. Scientific articles of the Circular Economy kind have also been published in ecological economics at the microeconomic level, (Baradaran, 2023). The Circular Economy concept is the most current attempt to integrate economic activity and environmental well-being in a sustainable manner. For example, China has accepted a set of Circular Economy concepts as the foundation for its economic development. The Circular Economy emphasizes process redesign and materials recycling, which may lead to more

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sustainable business models, maximize environmental functioning, and human well-being, (Schröder, Lemille, & Desmond, 2020).

The Circular Economy has featured in the last two 'Five Year Plans' drawn up by the Chinese government and is being operationalized in China, (Feng, & Lam, 2021). Many Non-Governmental Organizations (NGOs) in affluent countries have promoted the notion of the CE throughout the previous decade. However, because the Circular Economy is relatively new in its conceptualization and implementation, there may be tensions and constraints inherent in its appropriation and application, (Buchmann-Duck, & Beazley, 2020).

2.2. Circular Economy and Sustainable Development

In recent decades, there has been an urgent need around the world to transition to environmentally friendly industrial and economic development, as well as sustainable sociotechnical systems, (Wesselink, Fritsch, & Paavola, 2020). Today, research has shown that global environmental conditions and irresponsible use of natural resources have put significant strain on Earth's life-support systems. Biodiversity loss, waste of fresh water resources, soil desertification from excessive land use for food production, increasing air pollution in urban areas, plastic pollution in the oceans, and dramatic climate changes are some of the most serious environmental problems encountered and extensively investigated in recent decades (Kolawole, &Iyiola, 2023).

Using the cyclical nature pattern as an example, the Circular Economy can be defined as a system of resource utilization in which elements are reduced, reused, and recycled (3R principles), reducing waste to a minimum and recycling rejected products back into the environment through the use of biodegradable materials, (Agyekum, & Amudjie, 2024). The average European consumes 14 tons of raw materials and generates 500 Kg of waste every year. The USA with 5% of the world's population used 24% of global energy resources and every American generates 2 Kg of waste per day. Many products-materials can be reused or repaired, thus reducing waste, (Bruno, Abis, Kuchta, Simon, Grönholm, Hoppe, & Fiore, 2021).

There is no consensus among experts on the definition of sustainable development, and the ways in which the circular economy, linear economy, and sustainable development are linked and compared can vary greatly. Some environmental scientists see "sustainable development" as a collection of initiatives that have been implemented inside a linear framework; consequently, for them, sustainable development and linear economy are inextricably linked, (Schröder, *et al*, 2020).

The circular economy thus provides a solution in which sustainable development is viewed as a failure when applied in a linear economy production model. Sustainable development, according to environmental economists, is a concept that exists independently of previous unsuccessful endeavors, (Hajian, & Kashani, 2021). Sustainable development is a macro-level societal goal that encompasses broad conceptions of ecological, economic, and developmental sustainability, whereas the circular economy approach is primarily defined at the micro-level using a consumption and production model, (Lima, Jesus, Ortiz, Frascareli,

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Souza, & Mariano, 2021). If the use of circular initiatives leads to improved results towards sustainability, then the circular economy becomes a tool for sustainable development.

2.3. Circular Economy and Public Procurement

The term "circular economy" has come to refer to a vast range of human activities, (Schröder, et al., 2020). Over the last few decades, national governments and supra-governmental institutions such as the European Commission have used a variety of policy tools to promote environmentally sustainable human activities and behavior, with the objective of achieving zero environmental impact, (Schröder, et al., 2020).

The circular economy (CE) concept has gained popularity in recent years as a long-term alternative to the traditional linear economic model, which is defined by the "take, make, dispose" method, (Chizaryfard, et al., 2021). The circular economy aims to close the loop on product lifecycles by improving resource efficiency, minimizing waste, and reusing materials.

The circular economy appears to be regarded as a primary tool for combating alarming global phenomena ranging from economic and social instability (unemployment, social vulnerability, supply shortages) to environmental issues (biodiversity loss, water, air, and soil pollution, and resource scarcity), all of which contribute to climate change. Circular economy, (Genovese & Pansera, 2021). The European Union's (EU) political strategy sees the CE as a leading vehicle for achieving sustainability goals and, eventually, combating climate change. In the same vein, the South African government (SA) recognizes the importance of the CE in developing a resource-efficient, low-carbon, and internationally competitive economy, (Bleischwitz, Yang, Huang, Xiaozhen, Zhou, McDowall, & Yong, 2022).

According to Ruiz-Campillo, (2019), Transitioning to a more circular economic model is a critical step in meeting the EU Green Deal's aim of becoming the first climate-neutral continent by 2050 and decoupling economic growth from resource extraction while maintaining long-term competitiveness. The CE will accelerate the regenerative growth paradigm and make progress in limiting raw material usage within planetary boundaries. Furthermore, it will aid in the security of research and innovation for the green and digital transitions, as well as the development of EU capacity for vital raw materials, in order to avoid supply chain disruptions that would harm the industry and single market. According to the EU's goal, CE is also important in product design.
Another big concern in public procurement is the widespread corruption and fraud in public procurement. According to Wrage, & Birenbaum, 2024), corruption can occur at any stage of the procurement process, such as bid rigging, bribery, and kickbacks.

Capacity limitations also impede successful public procurement. Many government procurement groups lack the necessary skills and competencies to undertake complex procurement duties. According to Nani, & Ali, (2020), developing procurement authorities' capacity through training and professional development programs is crucial for improving procurement effectiveness.

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Despite increased interest in incorporating circular economy (CE) principles into public procurement, there is still a considerable knowledge gap in the systematic creation and practical application of frameworks to guide this process. This gap impedes the successful implementation of circular procurement methods and restricts the environmental, economic, and social benefits that such integration could provide.

3.0. METHODOLOGY

3.1. Research Design

A mixed research methodology was employed for this study. The mixed method comprise quantitative data and case study technique was applied for this study. The case study technique is appropriate for theory development and investigating complex phenomena in their natural setting, (Paparini, Green, Papoutsi, Murdoch, Petticrew, Greenhalgh, & Shaw, 2020). The research was carried out using a three-phase methodology that includes: literature evaluation; quantitative data collection through survey and analysis; case study selection & analysis, and framework construction respectively. The details of each phase are discussed as follows:

Phase 1: Literature Review

An intensive literature review of existing research on circular economy and public procurement was carried. Key subjects covered by the literature review include, definitions and concepts of circular economy, and the impact of circular economy, which are in tandem with the views of (Arruda, Melatto, Levy, & de Melo 2021). The Literature review also looked at other areas like: the role of public procurement in improving sustainability, and current methods of circular economy integration in procurement processes, which are in line with the recommendations of Lăzăroiu, et al.,(2020). This phase will also identify gaps in the existing literature that the study intends to remedy.

Phase 2: Case Study Selection and Analysis

At this phase, three public procurement entities that have begun to implement circular economy principles were selected for study. Geographic variety, differing levels of economic growth, and different stages of circular economy implementation were considered in selecting candidates. Semi-structured interviews were used to collect data, alongside with document analysis and participant observation.

i. **Quantitative data collection through survey and analysis:** Quantitative data were collected through survey and analyzed to make research decision.
ii. **Document Analysis:** Procurement policies, guidelines, and tender documents were reviewed to better understand the formal structures that enable circular economy.
iii. **Document Analysis:** Procurement regulations, guidelines, and tender documents were reviewed to better understand the formal procedures that enable circular economy.

Phase 3: Framework Development

Based on the findings of the case studies, a draft framework for incorporating circular economy principles into public procurement was developed. This approach was an iterative

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process; including input from a Delphi panel of experts in circular economy, public procurement, and sustainability, (Gebhardt, Spieske, & Birkel, 2022). The developed framework has key components such as policy proposals, procurement procedures, capacity-building measures, and stakeholder engagement techniques.

3.2. Population

The target population for this study includes individuals and groups directly involved or significantly affected by public infrastructure procurement in Nigeria. The study populations of 150 procurement professionals were chosen from whom the respondents were drawn using the formula proposed by Yamane in 1967, cited by Kiarie (2020), to arrive at the sample size. The selection formula is as follows:

$$n = \frac{N}{1+Ne^2}$$ Equation 1

Where n → the required sample size; N = is the Target Population (150 employees)
e = accuracy level required. Standard error = 5%

Sample calculation

$$n = \frac{150}{1 + 150 * (0.05)^2}$$

$$n = \frac{150}{1.375} = 109.09$$

n= 109

Therefore, minimum of 109 respondents are required for this study.

3.3. Sampling Plan and Sample Size

The study employed a purposive sampling method to select participants who possess relevant knowledge and experience.

3.4. Data Collection

The case study and quantitative data are the primary data for this study. Both case study and quantitative data collection are on-going near completion through the following methods:

- **Document analysis**: Reviewing existing procurement policies, reports, and relevant documents to understand the current state of procurement practices and identify potential meeting points between integrating circular economy and public procurement.
- **Surveys**: Distribution of surveys to a broader audience within the procurement departments to gather quantitative data on current practices and perceptions.

3.5. Data Analysis

In order to obtain useful insight from the study, data were collected and examined to test research hypothesis using descriptive and inferential statistical techniques. The quantitative data were subjected to analysis as to facilitate decision making on formulated hypotheses. As

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such, this study employed both inferential and descriptive statistics to analyze the data with the aid of Statistical Package for Social Sciences (SPSS).

3.6. Decision Rule

The Decision Rule states that reject null hypothesis if calculated value is less than critical value. However, accept null hypothesis if calculated value is greater than critical value (tabulated value).

4.0. RESULT AND DISCUSSION

4.1. Assessments of Demographic Characteristics of Respondents

Data analysis, interpretation and discussion is presented in this section. The main analysis is preceded by the summary of the demographic characteristics of the respondent are presented in Figures 1 to 6 respectively. This section explored descriptive statistics to explain the demographic data of respondents. Survey questions 1 to 6 captured the demographic statistics of the respondents as follows:

Age Distribution of Respondents

The age distribution of respondents is presented in Figure 1.

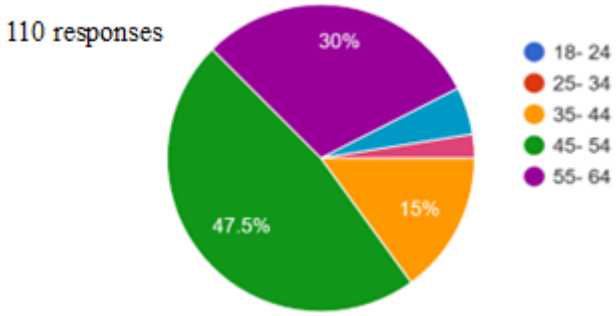

Figure I: Age Distribution of Respondents
Source: Authors' Field Survey (2024).

Figure I, presents age distribution of respondents. A total of 110 responses were received for this particular question. 6 (5.5 percent) of the respondents are between the ages of 18-24; 17 (15 percent) are within the ages of 25 - 34; 2 (2 percent) are within the ages of 35 – 44; 52 (47.5 percent) are within the ages of 45–54; while the 33 (30 percent) are within the ages of 55– 64. The modal age range of respondents is 45 – 54 years, indicating that most of the respondents are young people who in the prime of their careers and capable of contributing meaningfully to their respective organizations. The age distribution obtained indicates that the respondents were old enough to comprehend the main points of the study.

Gender of Respondents

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Gender of distribution respondents is presented in Figure 2.

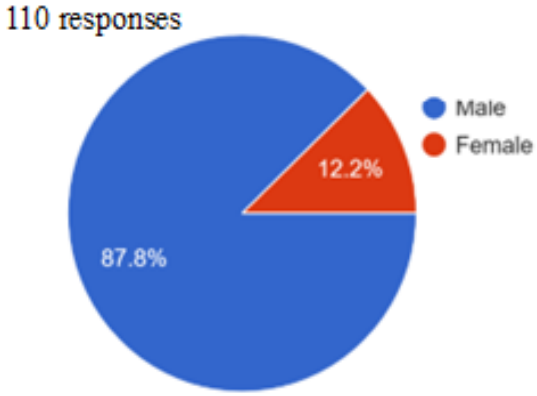

Figure 2: Gender Distribution of Respondents
Source: Authors' Field Survey (2024).

Figure 2 presents the gender distribution of respondents**.** A total of 110 responses were received, out of which 97 (87.8 percent) of respondents are males; while the remaining 13 (12.2 percent) are females, indicating that more of the respondents are males.

Educational Qualifications of Respondent

Educational qualification of respondents is presented in Figure 3.

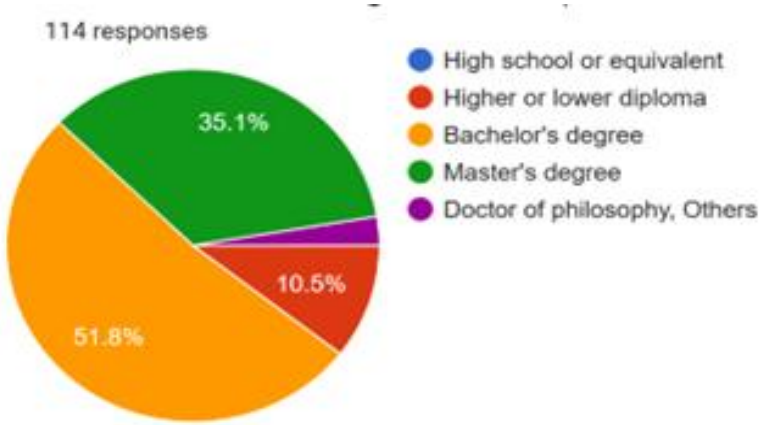

Figure 3: Educational Qualifications of Respondents
Source: Authors' Field Survey (2024).

Figure 3 presents educational qualifications of respondents. A total of 114 responses were received. Educational backgrounds of the respondents, according to the survey, indicates that 3 (2.8 percent) are PhD holders; 40 (35.1 percent) are M.Sc. holders; 59 (51.8 percent) are B.Sc. holders; while the remaining 12 (10.5 percent) are higher diploma OND holders. This also indicates that a greater percentage of the respondents are educated enough to contribute meaningfully to the survey.

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Years of Experience of Respondents in Procurement

The years of experience of respondents in procurement is presented in Figure 4.

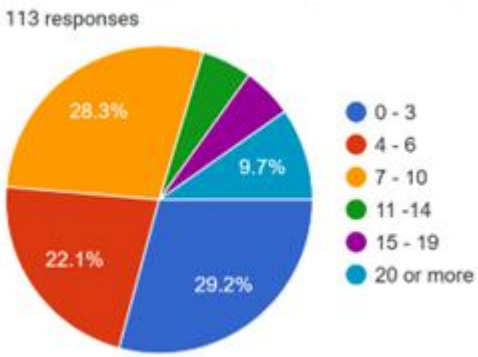

Figure 4: Years of Experience of Respondents in Procurement
Source: Authors' Field Survey (2024).

Figure 4 presents summarized data on respondents' years of experience in procurement job role. A total of 113 responses were received for this particular question. The survey further shows that 33 (29.2 percent) of the respondents had 0-2 years of experience in procurement; 25(22.1 percent) of respondents had 4-6 years of experience in procurement; 32 (28.3) had 7-10 years of experience in procurement; 6(5.4 percent) had 11-14 years of experience in procurement; 6 (5.3 percent) had 15-19 years of experience in procurement; while the remaining 11 (9.7 percent) of respondents had more than 20 years of experience in procurement.

Current Job Title/ Role of Respondents

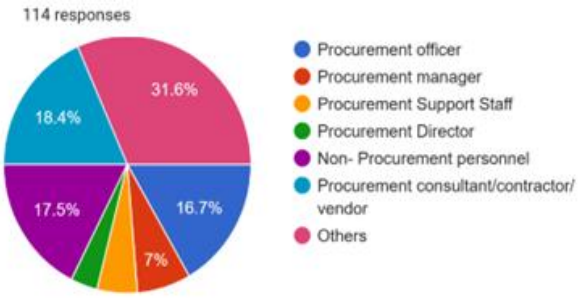

Figure 5: Current Job Title/Role of Respondents
Source: Author's Field Study (2024**).**

Figure 5 presents information on job title/role of respondents. A total of 114 responses were received for this particular question. It can be observed that 4 (3.8 percent) are Procurement Directors; 8 (7 percent) are Procurement Managers; 19 (16.7 percent) are Procurement Officers; 6(5 percent) are Procurement Support Staff; 20 (17.5 percent) are Non-Procurement Professionals; 21 (18.4 percent) respondents indicated that they are "procurement Consultant", while the remaining 36 (31.6 percent) chose others.

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Industry Sector where Respondents work

Information on the industry sector where respondents work is presented in Figure 6.

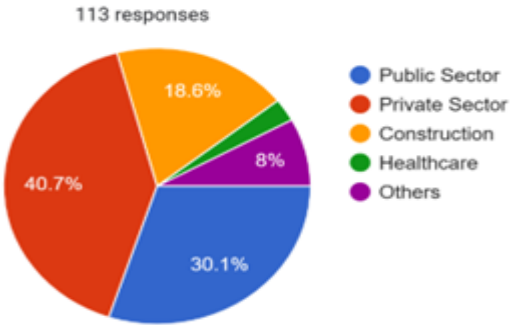

Figure 6: Industrial Sector where Respondents work
Source: Field Study (2024).

Figure 4.6, presents summary of information on industry sector where respondents work. A total of 113 responses were received for this particular question. 34 (30.1 percent) of respondents were from the public sector; 46 (40.7 percent) are from private; 21 (18.6 percent) worked for construction industry; 3 (2.6 percent) of sampled respondents worked for healthcare industries; while the remaining 9 (8 percent) of the sampled respondents chose others.

4.2. Evaluations and Tests of Research Hypotheses

In consideration of the four research hypotheses that were developed from research questions 1 and 2; research objectives 1 and 4. The study employed a 5-point Likert scale with the following values assigned are as: 5 for strongly agreed (SA); 4 for agreed (A); 3 for Neutral (N); 2 for disagreed (D); and 1 for strongly disagreed (SD), were adopted from the works of Dourado, Volpato, de Almeida-Pedrin, Oltramari, Fernandes, and Conti, (2021).

4.2.1 Potential impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria.

$H0_1$: There are no potential impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria.

ANOVA was employed on SPSS to analyze the quantitative data presented in Table 1; and used to test research hypothesis ($H0_1$) at 0.05 level of significance. The following P-values 0.010 and 0.000 were obtained for survey question 7 and 8 respectively.

Decision

Each of the obtained P-values 0.010 and 0.000 at 0.05 level of significance is lower than 0.05 (95 percent confidence interval of the difference), which indicates that there are significant impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria. Hence also by applying the decision rule stated earlier in section 3.6; the null hypothesis (Ho_1) is which states that "There are no potential impacts of integrating circular economy principles into public procurement on sustainability and

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resource efficiency in Nigeria" is therefore rejected. while the alternative hypothesis (H_1) which states that "There are potential impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria" is hereby accepted.

Table 1 Summary of Analysis of Survey question 7 and 8 data

Question	SD	D	N	A	SA	df	Sum of square	F	Sig.	Decision
7.Circular economy principles promote energy efficiency and the use of low-carbon materials, contributing to a reduction in greenhouse gas emissions.	34	45	15	8	12	113	179.447	6.552	0.010	**Reject Ho_1**
8. Circular procurement can lead to cost savings over the long term through the reduced need for raw materials, energy, and waste management.	46	30	21	4	13	113	195.754	8.293	0.000	**Reject Ho_1**

Source: Authors' Analysis (2024).

4.2.2 Comprehensive framework to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria

$H0_2$: There is no comprehensive framework to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria.

ANOVA was employed on SPSS to analyze the quantitative data presented in Table 2; and used to test research hypothesis ($H0_2$) at 0.05 level of significance. The following P-values 0.288 and 0.495were obtained for survey question 9 and 10 respectively.

Decision

Each of the obtained P-values 0.288 and 0.495at 0.05 level of significance is higher than 0.05 (95 percent confidence interval of the difference), which indicates that the study is significant. Hence also by applying the decision rule stated earlier in section 3.6; the null hypothesis (Ho_2) is which states that "there is no comprehensive framework to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria" hereby accepted. This implies that there is no existing comprehensive framework to guide public institutions in incorporating circular economy principles into their procurement processes in Nigeria.

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Table 2: Summary of Analysis of Survey question 9 and 10 data

Question	SD	D	N	A	SA	df	Sum of square	F	Sig.	Decision
9. The absence of effective monitoring and evaluation tools to assess the impact of circular procurement initiatives can hinder the ability to measure progress and make necessary adjustments. In Nigeria.	46	30	21	4	13	113	195.754	1.263	0.288	**Accept Ho_2**
10. The extent to which circular economy principles align with the current political agenda and government priorities will impact the development of the framework.	48	26	20	8	12	113	202.947	.852	0.000	**Accept Ho_2**

Source: Authors' Analysis (2024).

4.3. Development of Framework

The framework was developed on the principle of Waste minimization, resource efficiency and product life extension. The works of several authors were reviewed under section 2 (literature review), to gather adequate information in framework development. The knowledge gained were applied to develop a novel framework presented in Figure 7.

The central node stands for Nigeria's fundamental public procurement system, which serves as the hub for integrating Circular Economy (CE) ideas. The method by which Nigerian government agencies purchase products, services, and labor from outside vendors is known as public procurement. To promote sustainable development, this system must incorporate CE principles.

Key Components of Developed Framework:
The components are categorized into three different levels according to their hierarchy of importance. These are level 1, being the main factors; level 2, are the sub-factors based on Nigerian context; while level 3, are the outer layer.

Level 1:

i. Waste Minimization: The goal of this concept is to choose items that are durable, reusable, and recyclable in order to minimize the amount of trash produced during the procurement lifetime.

ii. Resource Efficiency: Resource efficiency pertains to the efficient utilization of resources, including energy and commodities, during the procurement process. This idea makes sure that the least amount of resources are needed to accomplish the intended results.

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iii. Product Life Extension: This idea promotes the purchase of goods with long lifespans that can be updated, mended, or repurposed to lessen the need for frequent replacements.

iv. Closed-Loop Supply Chains: By recycling, remanufacturing, and reusing materials, closed-loop supply chains seek to prolong the lifespan of goods and resources.

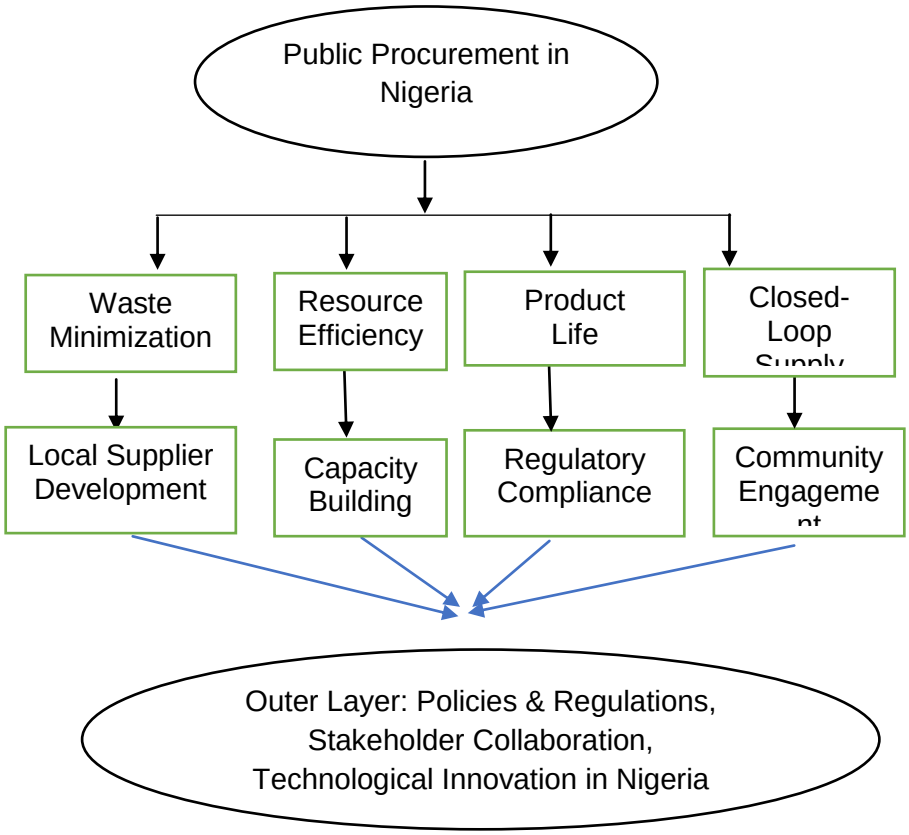

Figure 7: Developed novel framework to integrate circular Economy into public Procurement in Nigeria.
Source: (Authors' Credit)

Level 2: (sub-Branches Specific to the Nigerian Context)

i. **Local Supplier Development:** Creating local vendors capable of delivering goods and services compliant with circular economy guidelines supports the Nigerian economy and fosters sustainability.

ii. **Capacity Building:** To guarantee efficient implementation, capacity building entails educating suppliers and procurement authorities on circular economy principles. Improving knowledge and skills related to sustainable buying methods is crucial.

iii. **Regulatory Compliance:** Ensuring that procurement practices comply with national laws and regulations that support sustainability is essential for successful circular economy integration.

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iv. **Community Engagement:** Involving local communities in the procurement process guarantees that sustainable procurement efforts have broad support and that the advantages of circular economy practices are shared.

Level 3 (Outer Layer):

i. **Policies & Regulations**: An essential component that makes circular economy integration possible in Nigeria is the legislative and regulatory structure that controls public procurement. Sustainable behaviours must be required by policy, and their enforcement must be guaranteed.

ii. **Stakeholder Collaboration:** The effective integration of corporate environmental values into procurement requires cooperation amongst several parties, including suppliers, NGOs, the government, and the business sector.

iii. **Technological Innovation:** The capacity to monitor, report, and apply circular economy principles may be substantially improved with the use of technology. Innovation in technology can help Nigeria move toward more environmentally friendly buying methods.

4.3.1. Variables of the Developed Framework

i. Dependent Variables: These are results that are impacted by using circular economy principles. The dependent variable of this framework include: the amount of waste reduced; resource efficiency achieved; product lifespan; sustainability of supply chains; local supplier capacity; and community engagement.

ii. Independent Variables: These are variables that can be changed or manipulated to get the intended results. The independent variable of this framework include: the selection of products, investment in local suppliers, training programs, regulatory enforcement, and technological adoption.

Conclusively, this novel framework defines the crucial elements that must be controlled in order to produce positive results, in addition to offering a road map for incorporating the concepts of the Circular Economy into Nigerian public procurement.

5.0. CONCLUSION AND RECOMMENDATIONS

The research objectives 1 and 2 of the study were achieved leading to the following conclusions was made:

i. There are potential positive impacts of integrating circular economy principles into public procurement on sustainability and resource efficiency in Nigeria.
ii. A novel and comprehensive framework was successfully developed to facilitate the integration of circular economy principles into public procurement practices in Nigeria.

Based on the findings of the study, four-point recommendations were proposed as follows:

The study recommends regular training and capacity building of procurement

i. professionals who are to implement "Circular Economy" principles.

ii. Intensive monitoring and evaluation of the effectiveness of "Circular Economy" integrated procurement processes.

iii. key performance indicators (KPIs) should be developed and regular review mechanisms to ensure continuous improvement.

The study's primary practical contribution is the development of a framework that public sector organizations can use to integrate Circular Economy principles into their procurement processes.

Competing Interest

The authors have declared that no conflicting interest exist in this paper.

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